

## NEW TREMATODES FROM AN AUSTRALIAN SILUROID.

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The Australian freshwater jewfish, or catfish, *Tandanus* (or *Copidoglanis*) *tandanus*, has a wide distribution in the eastern half of the continent, and several parasites have been recorded as occurring in it, *viz.*, a Gyrodactyloid trematode, *Anchylodiscus tandani*, Johnston and Tiegs, from the gills; a Caryophyllaeid cestode, *Lytocestus* (*Balanotaenia*) *bancrofti*, Johnston, from the intestine; a trematode, *Isoparorchis* sp., Johnston, from its gas bladder; and a Trypanosome, *T. bancrofti*, Johnston and Cleland, from its blood—all from Queensland localities. Most of the material referred to above, as well as most of that described in this paper, was collected by Dr. T. L. Bancroft, or his daughter, Dr. M. J. Mackerras, to both of whom thanks are due. The paper contains an account of two species of trematodes which occur in the gas bladder of this fish.

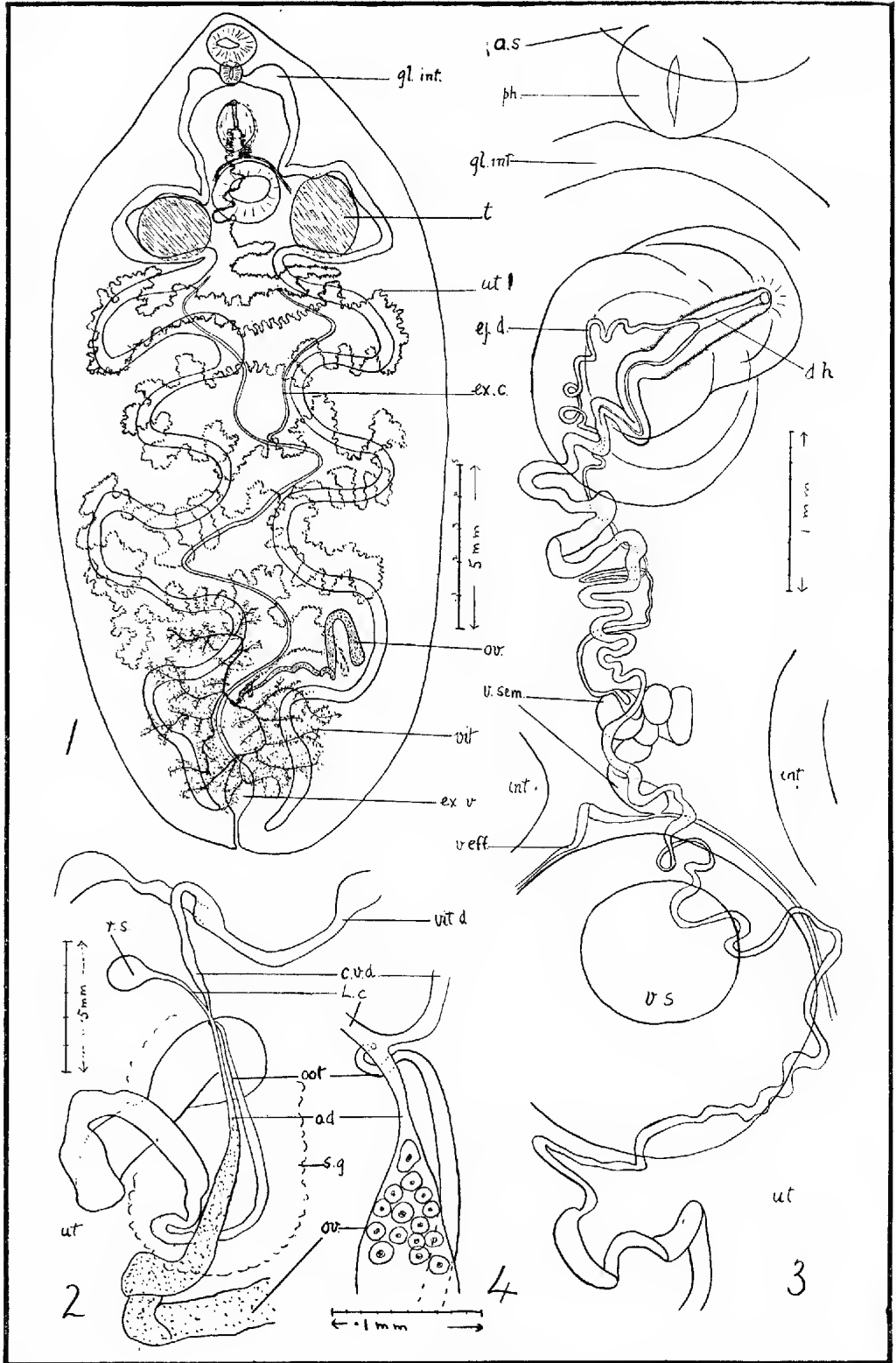
*Isoparorchis tandani*, n. sp.

A. Figs. 1-4.

This is a large trematode, specimens examined measuring 30 mm. by 15 mm. (somewhat compressed), 25 mm. by 12 mm., and 21 mm. by 11 mm., while the smallest measured 17 mm. by 8 mm. and possessed abundant ripe eggs. The anterior end is thickest and somewhat pointed, the posterior being rounded. There is little variation in the width of the parasite from the region of the testes to that of the ovary, though compressed specimens may show a considerable widening in the middle third.

The body (when preserved in formalin) is more or less transparent, the darkly-coloured uterus and intestine showing through very plainly, while the rounded whitish testes are also very obvious, especially from the dorsal aspect. The cuticle is smooth. In the case of the larger worms the diameters of the anterior and ventral suckers were 1.7 mm. and 2.1 mm. respectively (ratio 1:1.2); 1.6 mm. and 2.1 mm. (ratio 1:1.3); 1.0 mm. and 1.2 mm. (ratio 1:1.2). The prominent ventral sucker is situated at about one-fifth the body length from the anterior end. The genital pore lies in the midventral line and at a distance from the oral sucker about one-third the interval between the latter and the acetabulum. There is a muscular pharynx, about 0.6 mm. in diameter, continuous with the oral sucker which it partly overlies, and is succeeded by an extremely short oesophagus which overlies it dorsally. The latter soon branches into two long simple intestinal caeca which are thrown into a fairly regular series of curves—a slight one between the two suckers in the vicinity of the genital pore, then the limbs of the intestine approach the ventral acetabulum sucker very closely; then follows a wide loop partly investing the corresponding testis; this being followed by four others, the last being slight, while the one anteriorly to it lies in the vicinity of the ovary. The ends of the caeca approach very closely to the excretory vesicle at the posterior extremity of the worm. The extreme anterior portion of each caecum is specialised as a "glandular stomach" and differs in appearance from the rest of the tube.

The main excretory canal is long and sinuous, extending from the rather large excretory vesicle to a point near the middle of the length of the parasite, where it bifurcates, each limb passing forwards in a series of curves near the intestinal loops.



A. Figs. 1-4.

The testes are rounded, entire and approximately equal, measuring 1.5 mm. to 2 mm. in diameter. They lie on either side of the acetabulum, their anterior border being more or less on a level with the middle of the sucker. They are closely invested by the intestinal loops. The vasa efferentia arise from the inner anterior margins and pass just in front of the ventral sucker as very narrow tubes which soon join to form a swollen vesicula seminalis. The latter is thrown into a number of close coils and then becomes a very delicate, rather long, ejaculatory duct which travels in a sinuous or slightly coiled course above the uterine coils, and then diverges somewhat from the latter to enter the muscular genital sac. It terminates beside the uterine pore, at the bottom of the ductus hermaphroditicus.

The ovary is a long tubular organ, more or less bent in various directions, measuring over 9 mm. in the longest specimen examined, and over 6 mm. in the next longest. The width is about 0.25 mm. It may lie on either side, since in four mature specimens it was found on the right, and in two on the left. Its general position is more or less transverse, though the outer end may be bent posteriorly. Its inner portion becomes markedly narrowed into a short oviduct whose lumen is only 0.01 mm., sufficiently wide to admit the passage of an ovarian egg, the latter measuring about 0.015 mm. in diameter, but capable of elongating as it travels down the duct. The latter soon receives the vitelline duct and becomes sharply bent back on itself as the ootyp, which is very narrow (about 0.012 mm. in diameter). This uterine duct passes beside and immediately above the oviduct for a short distance, and then widens into the uterus in the vicinity of the lower (*i.e.*, inner) part of the ovary, becoming thrown into a series of coils and loops, some of which overlie the uterine duct. The uterus is a very long, rather narrow, duct thrown into a series of wide curves passing across the worm between and slightly beyond the intestinal caeca and dorsally to them, each curve being thrown into a series of smaller undulations. In the vicinity of the acetabulum the tube becomes narrow again, passing above dorso-laterally to the sucker, thence forwards below the vesicula seminalis and ejaculatory duct to enter the muscular genital sac and terminate at the ductus hermaphroditicus.

The genital sac, which, apparently, is homologous with the cirrus sac of other trematodes, is a very muscular organ, 0.8 mm. to 1 mm. wide, surrounding the terminal part of both male and female ducts, particularly the latter. The ductus is eversible, as some preparations show the organ partly extruded as a wide structure projecting through the genital pore. The enclosed portion of the uterus and ductus is surrounded by a layer of deeply-staining (? glandular) cells.

The two vitelline glands are greatly branched and lie in the posterior quarter of the parasite, the one on the ovarian side being rather more posteriorly situated than its fellow, and, besides, it invades the other side somewhat. The glands are markedly dendritic, each consisting of about five main branches which subdivide two or three times and terminate in a great number of short processes, so that the two glands appear somewhat like an irregular broken network occupying the space behind the uterus and ovary and between the intestinal crura, though they overlap parts of the latter and may extend laterally beyond them. Except in the vicinity of the shell gland no part of the ovary or uterus is covered by the vitellarium. The two glands are connected by a swollen duct from the narrower mid-region of which a common vitelline duct is given off ventrally to curve forwards and after a short course join the oviduct as it enters the shell gland. At the junction there is given off dorsally a short Laurer's canal terminating blindly in a rounded

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#### DESCRIPTION OF TEXT FIG. A.

References to the lettering will be found at the end of the article.

*Isoparorchis tandani.*

Fig. 1: Entire worm, ventral view. 2: Female organs. 3: Male ducts, etc. 4: Junction of oviduct and other ducts.

or pyriform receptaculum seminis, 12 mm. in diameter, which lies ventrally to parts of the vitellarium. The shell gland is not a very obvious structure in stained preparations, though it occupies a considerable area, about 1 mm. by .65 mm. Eggs are thin-shelled and measure  $45\ \mu$  to  $52\ \mu$  by  $25\ \mu$  to  $27\ \mu$ . At the end opposite the operculum, the shell shows a small rounded apical thickening. The miracidium while enclosed in the shell is about  $40\ \mu$  long.

The species obviously belongs to *Isoparorchis*, Southwell (1913), whose type species, *I. trisimilitubis*, occurs in the gas bladder of an Indian Siluroid, *Wallago attu*. The form herein described was recorded by me (1914) under its generic name only, from *Tandanus tandanus*, obtained from the Condamine River (Murray-Darling system) in Southern Queensland, and later (1916) from the same host species in the Dee (Dawson-Fitzroy system) and Burnett Rivers which belong to the Pacific slopes.

In 1920 Kobayashi (p. 396) described a new genus and species, *Leptolecithum eurytremum* as infesting the gas bladder of certain Japanese Siluroids. In June, 1926, Bhalerao announced the synonymy of the two genera, tabulated the chief characters of the two parasites, and concluded that they belonged to Southwell's species. He also mentioned that the ovary was situated on the right in the Indian parasite, and that perhaps Kobayashi may have been in error in describing the organ as lying on the left in the Japanese material examined. I have shown above that both men may have been correct in their statements, as the organs may be placed either on the left or on the right side in the Australian species. A comparison of the figures given by Southwell and Kobayashi, together with the distribution of the hosts in each case, leads one to disagree with Bhalerao's view as to the identity of the species. There are marked differences in regard to the general outline of the worms; the relative sizes of the two suckers and their distance from one another in relation to body length; the size of the testes; and the position at which the main excretory stem bifurcates. It is in all of these points that both *I. trisimilitubis*, Southwell, and *I. eurytremus* (Kobayashi) differ from *I. tandani*. All known members of the genus occur in the gas bladder ("gall bladder" in Bhalerao's table, p. 247, being obviously a misprint for gas bladder) of Siluroids.

Kobayashi placed his genus in the Hemiuridae and stated that it was related to the *Distomum clavatum* group. This latter assemblage has been assigned to *Hirudinella*, and was regarded by Odhner (1911) as belonging to an undesignated subfamily, but Nicoll (1914) listed it under Accacoeliinae. Manter pointed out many similarities to the Azygiidae except in regard to the form of the vitellaria (which are tubular in *Hirudinella*) and the position of the ovary and testes, the latter being immediately postovarian. The strongly muscular body of *Hirudinella* as well as the position of the various sex organs mark the genus off sharply from *Isoparorchis*. In *Accacoelium* the testes are postacetubular, one behind the other, the ovary a little distance posttesticular and the vitellaria dendritic along each side of the body. Except for the position of the vitellaria, *Isoparorchis* shows certain similarity to *Leuceruthrus* (which is usually placed in the Azygiidae in spite of the relative positions of the testes and ovary, though Goldberger, 1911, regarded it as probably representing a new family), and especially to *Halipegus*.

*Isoparorchis* does not seem to fall into any of the known subfamilies of Hemiuridae, though it appears nearer to the Accacoeliinae. It is suggested that a new subfamily Isoparorchinae be erected to receive the genus, a provisional diagnosis being:—Hemiuridae; body weakly muscular; posterior region not telescopic; testes preovarian, near acetabulum; ovary posttesticular; vitellaria dendritic, postovarian; uterus preovarian.

Both *Halipegus*, Looss, and *Derogenes*, Luhn—especially the latter—show affinities with the new subfamily, though the form of the vitelline glands differs in each case, being dendritic in *Isoparorchis*, rounded in *Derogenes*, and composed

of a few short rounded lobes in *Halipegus*. It is of interest to note that Luhe (1909) placed these two genera in the vicinity of the Dicrocoeliinae and Hemiuridae, whereas Pratt (1902) included *Derogenes* in the latter and regarded *Halipegus* and *Accacoelium* as related to the Syncoeliinae. Nicoll (1910, p. 348) seems to have been in doubt regarding the systematic position of *Derogenes*, as he listed it under "subfamily (Derogeninae)," though he subsequently (1914, p. 487) placed it under the Syncoeliinae, as also did Manter (1926, p. 100). The absence of a cirrus sac in *Halipegus*, and the presence in *Derogenes* of a muscular organ surrounding the ends of both male and female ducts, as in *Isoparorchis*, should be noted.

**Tandanicola bancrofti, n. gen., n. sp.**

B. Figs. 1-5.

This semi-transparent trematode was collected from the gas bladder of *Tandanus tandanus*, from the Burnett River, at Eidsvold, by Dr. Bancroft and his daughter, Dr. J. M. Mackerras, while Mr. H. Tryon forwarded some from the same host species from the Condamine River, near Warwick, Queensland.

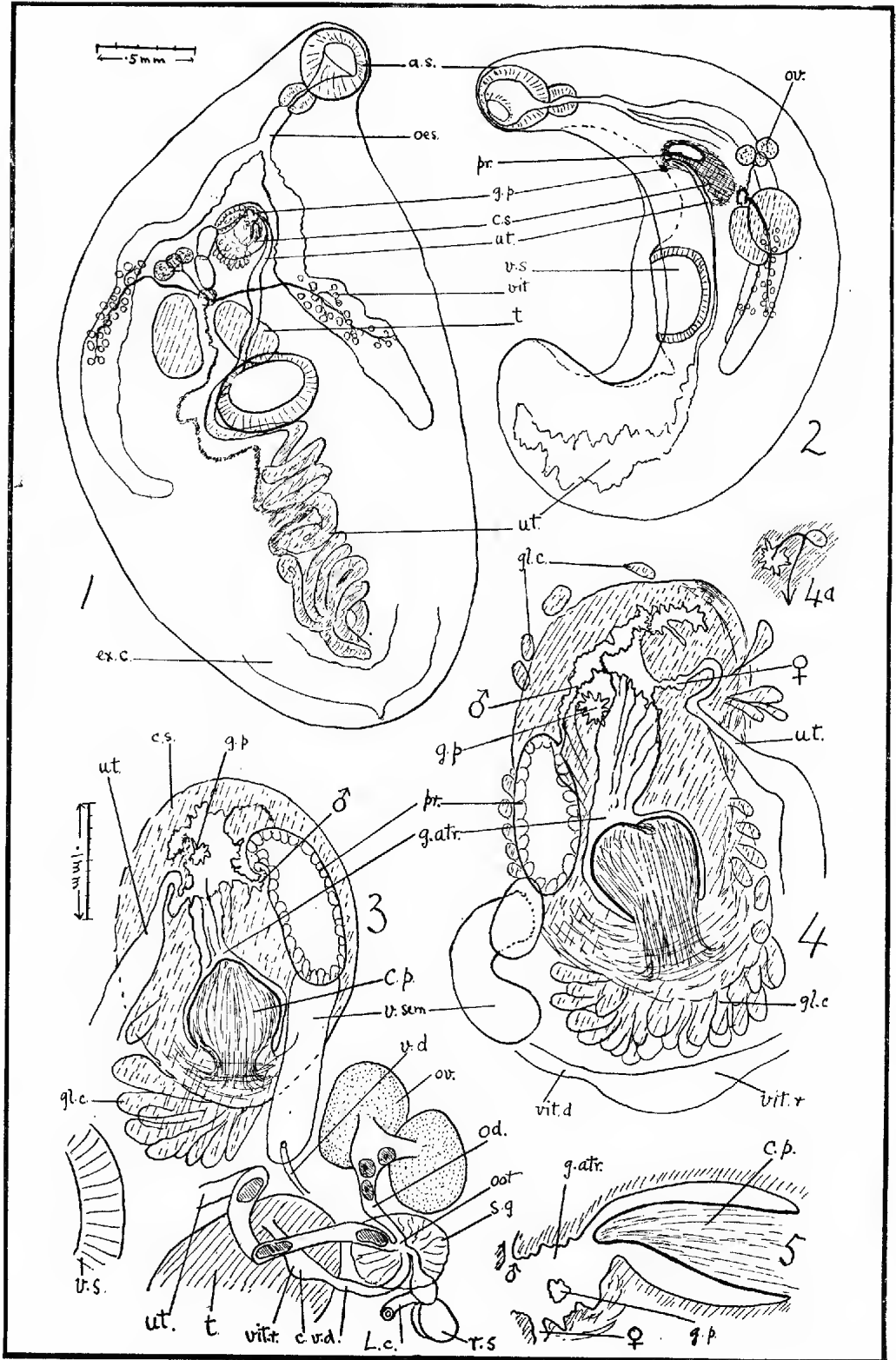
Preserved specimens are very pale, strongly flexed ventrally, the oral sucker more or less underlying the acetabulum, and the posterior end may also be bent somewhat ventrally, while the lateral edges may be slightly inturned. The largest specimen, when slightly compressed, measured about 3.8 mm. in length by 2 mm. in breadth, the greatest width being in the vicinity of the acetabulum, which is situated in the midbody. The anterior end narrows somewhat, but the posterior is rounded. The mouth is subterminal. Both suckers are well developed, especially the ventral, their respective diameters being 0.38 mm. and 0.48 mm., the ratio being about 4:5. The cuticle is smooth, except anteriorly, where it is very minutely scaly (under high power).

The pharynx, which has a diameter of about 0.17 mm. and a length of about 0.15 mm., is succeeded by an oesophagus 0.2 mm. to 0.3 mm. long; the latter branching into the two intestinal crura, which are fairly even in diameter and extend only slightly beyond the acetabular level. The inner portion of each crus may be somewhat crinkled.

The excretory canals form a U with very long, wide limbs with sacculate walls and extending anteriorly almost to the pharynx, and lying laterally from the intestinal crura. The pore is terminal.

The testes are slightly elongate, nearly elliptical, measuring 0.4 mm. by 0.22 mm., lying side by side, being separated by the uterine canal. They are situated just in front of the acetabulum, whose anterior border they may partly overlie. There is a prominent elongate swollen vesicula seminalis on the right of the median line, extending from the region of the shell gland forwards beside the ovary, between the latter and the genital sac. It may underlie portion of the ovary, while its anterior region is closely adjacent to and may partly overlie the sac. It then enters the latter to become a rather wide elongate rounded structure with markedly glandular walls, presumably constituting a prostatic region. There arises a very short duct from its anterior end to terminate in a strongly-folded pouch lying in anterior portion of the genital atrium, some distance in front of the papilla. The arrangement of the various parts is somewhat like that occurring in *Levinseniella*.

The genital sac is a conspicuous organ whose size varies in different specimens (0.15 mm. long by 0.13 mm. broad; 0.4 mm. by 0.2 mm.). It possesses abundant longitudinal and circular muscle fibres, while its exterior is provided with numbers of large cells which are especially numerous around the posterior end of the organ. They appear to be glandular. Projecting into the lumen of the sac is a very prominent copulatory papilla which is not traversed by the male duct. It varies in form in the different specimens examined, being broadly



B. Figs. 1-5.

rounded in some and more or less conical in others (0.08 mm. long by 0.09 mm.; 0.08 mm. by 0.08 mm.; 0.18 mm. by 0.07 mm., an elongate conical form), according to the degree of retraction. Its cavity contains abundant longitudinal muscle fibres inserted into the tip of the organ, while the surrounding copulatory sac is richly supplied with circular muscle fibres. The lumen of the atrium varies in dimensions according to the degree of retraction of the papilla; but its walls, like those of the papilla, are very strongly chitinised. They are also thrown into a series of very prominent longitudinal or spiral ridges when the papilla is retracted. The lumen is not straight, the outer part being bent or twisted more or less spirally, and projecting anteriorly to the genital pore which partly underlies the sac. Into the anterior part of the atrium there enter the uterus (metraterm) and the ejaculatory duct adjacent to a strongly folded pouch-like part of the wall in each case. The genital pore lies in the midline about midway between the two suckers, and is an insignificant aperture when the papilla is fully retracted. It then has strongly infolded walls like those of the atrium, but when the papilla is protruded through it, the lumen becomes more circular. The pore possesses a strong sphincter.

The ovary consists of three larger and one or two smaller rounded vesicles, some of which partly overlie others, the organ being situated on the right side in front of the right testis and between the intestine and vesicula seminalis, sometimes overlying part of the latter and of the genital sac. The oviduct travels inwardly and somewhat posteriorly towards the midline, to receive the common yolk duct or reservoir, then passes upwards to enter the shell gland, which measures 0.8 to 0.13 mm. in diameter. The latter lies ventrally to the yolk reservoir and is situated between, or just in front of, the anterior borders of the testes. Laurer's canal arises ventrally, immediately before the oviduct enters the shell gland, and curves around the latter dorsally as a very delicate tube which becomes swollen into one or more receptacula seminis and then fairly long and canal-like. The ootyp continues backwards in a slightly undulating course as a narrow uterine duct, at first above the shell gland and later lying between the testes or below one of them, thence above or to one side of the acetabulum, behind which it becomes widened into the uterus. The latter is thrown into a series of loops and coils occupying the midregion of the postacetabular part of the parasite, excepting the posterior end. The duct eventually travels forwards as a fairly wide canal above the acetabulum or to one side of it, thence below the left testis and vitelline duct, and then on the left side of the genital sac to terminate as a narrow tube opening into a cuticular pouch in the anterior part of the atrium. Eggs are thin-shelled, abundant, and measure 0.042 mm. by 0.025 mm. (uterine eggs, 0.032 mm. by 0.025 mm.).

The yolk glands lie laterally in the second quarter of the worm and consist on each side of 20 to 30 follicles, lying directly above the intestine. They are on approximately the same level as the testes, being preacetabular and postovarian. The main duct from each side passes directly inwards into the anterior border of the corresponding testis, the two ducts meeting just above the shell gland. They may overlie the ventral lobe of the ovary, the uterus, and the posterior part of the vesicula seminalis, but are ventral to the main mass of the ovary. The

#### DESCRIPTION OF TEXT FIG. B.

References to the lettering will be found at the end of the article.

##### *Tandanicola bancrofti*.

Fig. 1: Entire worm, ventral view. 2: Entire worm, lateral view. 3: Female organs (in part), also copulatory sac, etc., from a teased specimen. 4: Copulatory sac, etc. 4a: Sketch to indicate course of genital atrium from genital pore. 5: Another form of copulatory papilla, less retracted than those indicated in figs. 3 and 4.

Figs. 1 and 2 are drawn to scale indicated beside fig. 1; figs. 3, 4, and 5 to scale drawn beside fig. 3.

united duct may be swollen to constitute a vitelline reservoir which narrows immediately before joining the oviduct as it enters the shell gland.

In several specimens amphitypy was observed, the ovary, shell gland, and terminal portion of the uterus being on the left of the median line, instead of the right.

The general topography of the organs indicates that the worm belongs to the Brachycoeliidae, as diagnosed under subfamily title by Luhe (1909, p. 118). The absence of a typical cirrus sac and the position of the ovary and testes exclude it from Brachycoeliinae (s. str.). Though the Phagicolinae are devoid of a cirrus sac, yet the positions of the other organs prevent the inclusion of the parasite in that subfamily, and this remark would apply to the Lecithodendriinae. The parasite seems to be more nearly related to the Microphallinae in regard to the structure of the cirrus sac (Ward, 1901; Luhe, 1909), but the postacetabular position of all organs except the uterus and genital sac in the subfamily definitely eliminates the Australian parasite from it. A new genus *Tandanicola* and subfamily Tandanicolinae are therefore proposed for its reception, the following provisional generic diagnosis being suggested. *Tandanicola*, n. gen., Brachycoeliidae: Cuticle more or less minutely spiny; suckers well developed; prepharynx absent; pharynx and oesophagus present; intestinal crura extending to vicinity of acetabulum; testes compact, lying at same level, preacetabular, postovarian; ovary consisting of a few rounded lobes, pretesticular; cirrus sac absent, replaced functionally by a muscular copulatory sac with well-developed copulatory papilla; genital pore preacetabular; vitellaria consisting of comparatively few follicles, lying laterally above intestinal crura, preacetabular; uterus mainly postacetabular, restricted to midregion; excretory vesicle practically U-shaped. Type, *T. bancrofti*.

References to lettering: *a.s.*, anterior sucker; *c.p.*, copulatory papilla; *c.s.*, cirrus sac; copulatory sac; *c.v.d.*, common vitelline duct; *d.h.*, ductus hermaphroditicus; *ej.d.*, ejaculatory duct; *ex.c.*, excretory canal; *ex.v.*, excretory vesicle; *g.at.*, genital atrium; *gl.c.*, gland cells (?); *gl.int.*, glandular region of intestine; *g.p.*, genital pore; *int.*, intestine; *L.c.*, Laurer's canal; *od.*, oviduct; *oes.*, oesophagus; *oot.*, ootyp; *ov.*, ovary; *ph.*, pharynx; *pr.*, prostatic portion of male duct; *r.s.*, receptaculum seminis; *s.g.*, shell gland; *t.*, testis; *ut.*, uterus; *v.d.*, vas deferens; *v.eff.*, vas efferens; *vit.*, vitelline glands; *vit.d.*, vitelline duct; *v.r.*, vitelline reservoir; *v.s.*, ventral sucker; *v.sem.*, vesicula seminalis.

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